

BAYOU CARRON TMDLS FOR DISSOLVED OXYGEN AND NUTRIENTS

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BAYOU CARRON TMDLS
FOR DISSOLVED OXYGEN AND NUTRIENTS

SUBSEGMENT 060210

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources (NPS) discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO) and nutrients for Bayou Carron, subsegment 060210, in the Vermilion-Teche basin in southern Louisiana.

Bayou Carron, subsegment 060210, is a free flowing stream which receives drainage from areas dominated by agriculture. There are relatively few point source discharges in this subsegment. The largest point source discharge is the Town of Washington sewage treatment plant (STP).

This subsegment was listed on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority #1 for TMDL development. This subsegment was not included on the 1998 303(d) List, but was later added to the list based on LDEQ assessment data collected during June through December 1998. The causes for impairment cited in the 303(d) List included organic enrichment/low DO and nutrients. The water quality standard for DO for the subsegment is 5 mg/L year round.

A water quality model (LA-QUAL) was set up to simulate DO, biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen in the subsegment. The model was calibrated using data from FTN's synoptic survey in September 2000 and other various information obtained from LDEQ and USGS. The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing NPS loads were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

A TMDL for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) was calculated using the results of the projection simulation. Both implicit and explicit margins of safety were included in the TMDL calculations. The nutrient TMDL was developed based on Louisiana's water quality standard for nutrients, which states that "the naturally occurring range of nitrogen to phosphorus ratios shall be maintained". The nutrient TMDL was calculated using allowable nitrogen loadings from the projection simulation and applying a naturally occurring nitrogen to phosphorus ratio to determine the allowable phosphorus loadings.

Each TMDL for this subsegment includes a wasteload allocation (WLA) for the Town of Washington STP plus an additional WLA for all of the other point sources with minor oxygen demanding discharges within the subsegment. In order to meet the DO standard of 5 mg/L throughout Bayou Carron, NPS loads will need to be reduced by an average of 79%.

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1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for dissolved oxygen (DO) and nutrients for Bayou Carron, subsegment 060210. This subsegment was listed on the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000) as not fully supporting the designated use of propagation of fish and wildlife. This subsegment was not included on the 1998 303(d) List (LDEQ 1998), but was later added to the list based on LDEQ assessment data collected during June through December 1998. The suspected sources and suspected causes for impairment in the 303(d) List are included in Table 1.1. The subsegment was ranked as priority #1 for TMDL development. The TMDLs in this report were developed in accordance with the Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7. The 303(d) Listings for other pollutants in this subsegment are being addressed by EPA and the Louisiana Department of Environmental Quality (LDEQ) in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

Table 1.1. Summary of 303(d) Listing of subsegment 060210 (EPA 2000).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1 = highest)
060210	Bayou Carron	Minor municipal point source Non-irrigated crop production Septic tanks	Organic enrichment/low DO Suspended solids Turbidity Nutrients	1

2.0 STUDY AREA DESCRIPTION

2.1 General Information

Subsegment 060210 is part of the Vermilion-Teche basin in south central Louisiana (see map in Appendix A). The primary watercourse within subsegment 060210 is Bayou Carron, which generally flows from northwest to southeast. Bayou Carron has its headwaters in Evangeline Parish, drains part of western St. Landry Parish, and discharges into Bayou Courtableau. Tributaries to Bayou Carron include Bayou Petite Passe, Bayou Grand Louis, Coulee Garrique, and Bayou Belleview. River kilometers are referenced from the mouth of Bayou Carron at Bayou Courtableau (river kilometer 0.0). The stream channel for Bayou Carron is very sinuous. Land use data for the study area is shown in Table 2.1.

Table 2.1. Land uses in subsegment 060210 based on GAP data (USGS 1998).

Land Use Type	% of Total Area
Urban	0.0%
Fresh Marsh	0.0%
Saline Marsh	0.0%
Wetland Forest	10.6%
Upland Forest	2.4%
Wetland Scrub/Shrub	0.0%
Upland Scrub/Shrub	1.7%
Agricultural	83.0%
Water	2.3%
Barren Land	0.0%
TOTAL	100.0%

2.2 Water Quality Standards

The numeric water quality standards and designated uses for this subsegment are shown in Table 2.2. The primary numeric standard for the TMDLs presented in this report is the DO standard of 5 mg/L year round.

For nutrients, there are no specific numeric criteria, but there is a narrative standard that states “The naturally occurring range of nitrogen-phosphorus ratios shall be maintained.... Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance

or interferes with designated water uses shall not be added to any surface waters.”
(LDEQ 2000a).

Table 2.2. Water quality standards and designated uses (LDEQ 2000a).

Subsegment Number	060210
Waterbody Description	Bayou Carron
Designated Uses	ABC
Criteria:	
Chloride	40 mg/L
Sulfate	30 mg/L
DO	5 mg/L (year round)
pH	6.0 – 8.5
Temperature	32 °C
TDS	220 mg/L

USES: A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

In addition, LDEQ issued a declaratory ruling on April 29, 1996, concerning this language and stated, “That DO directly correlates with overall nutrient impact is a well-established biological and ecological principle. Thus, when the LDEQ maintains and protects DO, the LDEQ is in effect also limiting and controlling nutrient concentrations and impacts.” DO serves as the indicator for the water quality criteria and for assessment of use support. For the TMDLs in this report, the nutrient loading required to maintain the DO standard is the nutrient TMDL.

2.3 Identification of Sources

2.3.1 Point Sources

A list of NPDES permits for minor point sources that were identified in or near the Bayou Carron subsegment is included in Appendix B. These permits were identified by searching two sources of information. The primary source was a listing of all the permits in the Vermilion-Teche basin (basin number 06) from the LDEQ static database. The secondary source was a listing of all the permits in the Vermilion-Teche basin (hydrologic units 08080102 and

08080103) from EPA's Permit Compliance System (PCS) on the EPA website. All of the information concerning permit parameters and design flow in Appendix B was obtained by manually retrieving hard copies of permit files from LDEQ's file room.

Facilities without oxygen demanding parameters in their permit were assumed to exert a negligible oxygen demand in the receiving stream; therefore, these facilities were excluded from any further consideration in these TMDLs. All of the facilities with oxygen demanding parameters in their permit were included in the TMDL calculations, but only one was considered large enough to be modeled explicitly. The remaining oxygen demanding discharges were included in the TMDLs by adding their loads to the loading simulated in the model.

The point source that was explicitly included in the model was the Town of Washington Sewage Treatment Plant (STP). The approximate location of this discharger is shown in Appendix A. The permit records, permit applications, and Discharge Monitoring Reports (DMRs) for this facility were examined and appropriate input information for the calibration and projection modeling runs was derived to the maximum extent possible.

Relevant information for the discharge explicitly included in the model is listed below:

	<u>Town of Washington STP</u>
Permit number:	LA0062928 and WP1013
Receiving stream:	Bayou Carron
Design flow:	0.24 MGD
Permit limits:	10/15 mg/L BOD ₅ (daily avg./max., April to October) 15/23 mg/L TSS (daily avg./max., April to October) 2/4 mg/L NH ₃ -N (daily avg./max., April to October) 5 mg/L DO (daily avg./max. summer, April to October)
Treatment:	3 cell oxidation treatment system

2.3.2 Nonpoint Sources

Several NPS were cited as suspected sources of impairment in the 303(d) List (Table 1.1). These NPS include non-irrigated crop production and septic tanks.

2.4 Previous Data and Studies

Listed below are previous water quality data and studies in or near the subsegment in the study area. The location of the LDEQ ambient monitoring station is shown in Appendix A.

1. Twice monthly data collected by LDEQ for “Bayou Carron east of Washington, Louisiana” (station 670) for mid-June to December 1998.
2. Louisiana Department of Natural Resources (LDNR), Intensive Survey Data for Bayou Carron, 1980.
3. Limno-Tech, Inc., A Waste Load Allocation for the Washington Municipal Wastewater Treatment Facility, prepared for Louisiana Department of Natural Resources, 1984.

In 1980, an intensive water quality survey was conducted in the vicinity of a proposed STP for the Town of Washington to assess water quality and provide information on the potential impact of the STP. At that time, no known point sources existed in the study area. Samples were collected at four stations on Bayou Carron beginning approximately 10 km from its confluence with Bayou Courtableau. Conditions at that time indicated low DO at the sampled locations (1.7 to 2.6 mg/L). Concentrations of oxygen-demanding parameters were fairly low in relation to the low DO concentrations (BOD₅ concentrations ranged from 1.6 to 4.2 mg/L and ammonia nitrogen ranged from 0.12 to 0.21 mg/L). It was concluded from the study that sediment oxygen demand (SOD) and low reaeration may contribute significantly to low DO in the stream. Data were only collected along approximately 10 km of Bayou Carron during the 1980 intensive survey.

In 1984, a waste load allocation study was prepared for the Town of Washington STP before its construction. Model analysis indicated that effluent requirements of 5 mg/L BOD₅, 5 mg/L total suspended solids, and 2 mg/L ammonia at an effluent DO of 5 mg/L would be needed to maintain a minimum DO concentration of 2 mg/L in Bayou Carron. However, the DO standard for Bayou Carron at that time was 5 mg/L. Current permit limits for the STP are listed in Section 2.3.1.

3.0 CALIBRATION OF WATER QUALITY MODEL

3.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (version 3.02), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, ultimate carbonaceous biochemical oxygen demand (CBOD_u), and DO. Phosphorus and algae were not simulated because algae do not appear to have significant impacts on DO in this subsegment.

A vector diagram of the model is shown in Appendix C. The vector diagram shows the reach/element design and the location of the modeled inflows and point sources. Bayou Carron was divided into nine reaches to represent varying depths and widths along the subsegment. Based on the lack of extensive hydraulics and water quality data, each reach was represented as only one element.

3.2 Calibration Period

An intensive field survey was not performed for the study area due to schedule and budget limitations. A synoptic survey of the study area was performed by FTN in September 2000. Data were collected at two stations (670-2 and 670-1) on Bayou Carron as shown in Appendix A. Other water quality data that were considered for calibration were the LDEQ ambient monitoring data and the 1980 LDNR survey. The 1980 LDNR survey data were not selected for calibrating the model because the survey was performed before the Town of Washington STP started discharging to Bayou Carron. The LDEQ ambient monitoring data were available at only one location (LDEQ station 670) for a six-month period (June through December 1998). The water quality data from the FTN synoptic survey and from LDEQ's historical ambient monitoring are summarized in Appendix D. Based on the synoptic survey, the DO in Bayou Carron appears to exhibit some differences between the upper and lower ends of the stream. For simulating longitudinal gradients in water quality with the effects of the Town of

Washington STP included, the September 2000 synoptic survey was selected as the best available calibration data set. The calibration targets (i.e., the concentrations to which the model was calibrated) for each parameter at the two stations were set to the concentrations measured during the FTN synoptic survey in September 2000.

3.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the “LTP”; LDEQ 2000b). These correction factors were:

- Correction for BOD decay: 1.047 (value in LTP is same as model default)
- Correction for SOD: 1.065 (value in LTP is same as model default)
- Correction for ammonia N decay: 1.070 (specified in Data Group 4)
- Correction for organic N decay: 1.020 (not specified in LTP; model default used)
- Correction for reaeration: automatically calculated by the model

3.4 Hydraulics (Data Type 9)

The hydraulics were specified in the input for the LA-QUAL model using the power functions ($\text{width} = a * Q^b + c$ and $\text{depth} = d * Q^e + f$). Widths were estimated primarily from digital ortho-quarter quad maps. Depths were estimated from observed depths during the September 2000 synoptic survey (see Appendix E). Width and depth constants were assumed to be 0.0. Using default width and depth exponents of 0.12 and 0.45 (Leopold et al. 1964), respectively, width and depth coefficients for each reach were calculated based on the estimated flow at each reach. Values input for each reach are shown in Appendix E.

3.5 Initial Conditions (Data Type 11)

The primary parameter that is specified in the initial conditions for LA-QUAL is the temperature for each reach (because temperature was not being simulated). Temperatures for reaches 1 and 9 were set to the temperatures measured at Stations 670-1 and 670-2, respectively, during the FTN synoptic survey. Temperatures for reaches 2 through 8 were set to the average of the temperatures measured at the two stations. The input data and sources are shown in Appendix E.

For constituents not being simulated, the initial concentrations were set to zero; otherwise, the model would have assumed a fixed concentration of those constituents and the model would have included the effects of the unmodeled constituents on the modeled constituents (e.g., the effects of algae on DO).

3.6 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in LA-QUAL include reaeration rates, SOD, CBOD decay rates, nitrification rates, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix E.

The Louisiana Equation (option 15) was specified for reaeration in the model. The SOD rates were developed through iteration in the calibration. The SOD rate for each reach was adjusted so that predicted DO concentrations were similar to the calibration target values.

The CBOD decay rate was set to the default value of 0.10/day that LDEQ provided in its guidance for uncalibrated modeling of the Mermentau and Vermilion-Teche basins (LDEQ 2000c) and information in “Rates, Constants, and Kinetics Formulations in Surface Water Modeling” (EPA 1985).

Mineralization rates (organic nitrogen decay) in the model were set to 0.02/day for all reaches. This value was based on information in the “Rates, Constants, and Kinetics” publication (EPA 1985). Nitrification rates were set to 0.10/day for all reaches, which is consistent with guidance in the LTP based on stream depth. The combination of these rates is consistent with LDEQ’s guidance for uncalibrated modeling of the Mermentau and Vermilion-Teche basins (LDEQ 2000c). The LDEQ guidance specified a default rate of 0.05/day for nitrogenous biochemical oxygen demand (NBOD) decay, which represents the combination of mineralization and nitrification.

One other input option was specified for characterizing the nitrification process. In the program constants section of the model input file (data type 3), the nitrification inhibition option was set to 1 instead of the default of option number 2. With the default option, the nitrification rate drops rapidly when the DO drops below 2 mg/L, which results in an unrealistic build up of ammonia nitrogen at low DO. Option number 1 provides nitrification inhibition that is similar to

what is used in other water quality models such as QUAL2E and WASP (see Figure 3.5 in FTN 2000a).

3.7 Nonpoint Source Loads (Data Type 19)

The nonpoint source loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBOD loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia source rates (specified in data type 13), and the mass loads of organic nitrogen and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The values used as model input are shown in Appendix E.

These four calibration parameters were adjusted in a specific order based on the interactions between state variables in the model. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables affect the organic nitrogen concentrations. Next, the benthic ammonia source rates were adjusted until the predicted ammonia nitrogen concentrations were similar to the observed concentrations. Then the CBODu loads were adjusted until the predicted CBODu concentrations were similar to the observed concentrations. Finally, the SOD rates were adjusted until the predicted DO concentrations were similar to the observed concentrations. The DO was calibrated last because all of the other state variables affect DO.

3.8 Headwater and Incremental Flow Rates (Data Types 16 and 20)

The headwater inflow for Bayou Carron was based on velocity and cross section data at Station 670-2 taken during the September 2000 synoptic survey. Based on the estimated flow per square mile at Station 670-2, a flow at the mouth of Bayou Carron was calculated using the total drainage area of the watershed (USGS 1971). Incremental inflows were then calculated for each reach based on the length of the reach. Values used as model input are shown in Appendix E.

3.9 Headwater and Incremental Water Quality (Data Types 17 and 21)

Concentrations of DO, CBOD_u, organic nitrogen, and ammonia nitrogen were specified in the model for the headwater and for the incremental inflow for each reach. Water quality data collected at Station 670-2 was used to represent headwater quality during the calibration period. It was assumed that headwater water quality also represented water quality from small drainage areas. Therefore, incremental inflow water quality for each reach was set to the observed or calculated constituent concentrations at Station 670-2. The values used as model input are shown in Appendix E.

The September 2000 synoptic survey data included DO, TOC, TKN, CBOD₅, nitrite and nitrate, and ammonia nitrogen. Because the measured CBOD₅ at Station 670-2 was unusually high (13 mg/L), CBOD_u was estimated from TOC using the relationship between these parameters that was developed using data from the FTN synoptic survey in September 2000 and data from LDEQ's long term BOD analyses during 2000. The median ratio of TOC to CBOD₅ from the FTN synoptic survey data was 6.0 and the median ratio of CBOD_u to CBOD₅ from the LDEQ long term BOD data was 4.5. Combining these ratios yielded the following relationship that was used to develop model inputs:

$$\text{CBOD}_u = 0.75 * \text{TOC}$$

3.10 Point Source Inputs (Data Types 24 and 25)

CBOD_u, DO, and ammonia nitrogen concentrations and flow for the Town of Washington STP were based on values from the plant's September 2000 discharge monitoring report (DMR) for Permit Number WP 1013. The CBOD_u value used for model input was obtained by multiplying the BOD₅ value from the DMR by an assumed CBOD_u:BOD₅ ratio of 2.3 (which is consistent with the LTP). Organic nitrogen was set at twice the ammonia nitrogen concentration based on the relationship that was established for the Bayou Lacassine TMDL (FTN 2000a). The nitrite and nitrate concentration was set at the drinking water criterion of 10 mg/L. The values used as model input are shown in Appendix E.

3.11 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix F and a printout of the LA-QUAL output file is included as Appendix G. The calibration was considered to be acceptable based on the amount of data that were available.

4.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

4.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of a MOS in the development of a TMDL. For the TMDLs in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit MOS was used in developing the projection model.

Critical conditions for DO have been determined for the Vermilion-Teche basin in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in

the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cfs, whichever is higher, for all headwaters, and 90th percentile temperature for the summer season. Model loading is from point sources, perennial tributaries, SOD, and resuspension of sediments. In addition, all point sources are assumed to be discharging at design capacity.

In reality, the highest temperatures occur in July through August, the lowest stream flows occur in October through November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yields an implicit MOS that is not quantified. Over and above this implicit MOS, an explicit MOS of 20% for point sources and 10% for NPS was incorporated into the TMDLs in this report to account for future growth and model uncertainty.

4.2 Temperature Inputs

The LTP (LDEQ 2000b) specified that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled. Because the LDEQ station on Bayou Carron has only 6 months of data, LDEQ data from an adjacent subsegment were used for this analysis. In the Bayou Teche TMDL (LDEQ 2000d), long term temperature data from Bayou Courtableau at Washington, LA (LDEQ station 0102) were used to calculate a 90th percentile summer temperature of 28.3°C. This value was specified in data type 11 in the model input and is shown in Appendix H.

Because Bayou Carron has a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

4.3 Headwater Inputs

The inputs for the headwater for the projection simulation were based on guidance in the LTP. According to the LTP, the critical flow rates for summer should be set to either the 7Q10 flow or 0.1 cfs, whichever is higher. The USGS calculated a 7Q10 flow of 0.0 cfs for Bayou Carron through a regression analysis to a nearby gage (#08012000 on Bayou Nezpique, USGS 1980); therefore, the critical flow rate in the model was set to 0.1 cfs (0.003 m³/s). Because the 7Q10 flow is zero, the incremental inflow was set to zero in the projection simulation. The headwater DO concentration was set to 90% saturation at the critical temperature (as specified in the LTP). Concentrations for other parameters were the same as in the calibration. The values used as model input in the projection simulation are shown in Appendix H.

4.4 Point Source Inputs

For the Town of Washington STP, the flow was set to 125% of the design flow in order to incorporate an explicit 20% margin of safety. The concentrations for the Town of Washington STP discharge were based on the current permit limits for April through October. The values used as model input in the projection simulation are shown in Appendix H.

4.5 Nonpoint Source Loads

Because the initial projection simulation was showing low DO values in all of the reaches, the NPS loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. Within each reach, the same percent reduction was applied to all components of the NPS loads (SOD, benthic ammonia source rates, and mass loads of CBOD_u and ammonia nitrogen). The values used as model input in the projection simulation are shown in Appendix H.

4.6 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 4.2 through 4.5. All of the other model inputs (e.g.,

hydraulic coefficients, decay rates, reaeration equations, etc.) were unchanged from the calibration simulation.

4.7 Model Results for Projection

Plots of predicted water quality for the projection are presented in Appendix I and a printout of the LA-QUAL output file is included as Appendix J.

An average NPS load reduction of approximately 79% was required to bring the predicted DO values on Bayou Carron to at least 5.0 mg/L. Reductions of the NPS loads were necessary because the predicted DO was lower than the 5 mg/L standard in reaches upstream of the Town of Washington STP.

The percentage reduction for NPS loads mentioned above represents a percentage of the entire NPS loading, not a percentage of the manmade NPS loading. The NPS loads in this report were not divided between natural and manmade because it would be difficult to estimate natural NPS loads for the study area.

5.0 TMDL CALCULATIONS

5.1 DO TMDL

A total maximum daily load (TMDL) for DO has been calculated for the study area based on the results of the projection simulation. The DO TMDL is presented as oxygen demand from CBOD_u, organic nitrogen, ammonia nitrogen, and SOD. A summary of the loads for Bayou Carron is presented in Table 5.1.

Table 5.1. DO TMDL for Subsegment 060210 (Bayou Carron).

	Oxygen demand (kg/day) from:				Total oxygen demand (kg/day)
	CBOD _u	Organic N	Ammonia N	SOD	
WLA for Town of Washington STP	21	16	8	NA	45
WLA for minor point sources	14	NA	9	NA	23
MOS for all point sources	9	4	4	NA	17
LA for other NPS	88	10	0	486	584
MOS for NPS	10	1	0	54	65
Total maximum daily load	142	31	21	540	734

The oxygen demand from organic nitrogen and ammonia nitrogen was calculated as 4.33 times the nitrogen loads (assuming that all organic nitrogen is eventually converted to ammonia). The value of 4.33 is the same ratio of oxygen demand to nitrogen that is used by the LA-QUAL model. For the SOD loads, a temperature correction factor was included in the calculations (in order to be consistent with LDEQ procedures).

The WLAs for minor point sources represent the loads from small oxygen demanding discharges that were not explicitly modeled. In general, these WLAs were based on current permit limits with no reductions. For discharges with no permit limits for ammonia nitrogen, effluent concentrations for ammonia nitrogen were assumed based on the BOD₅ permit limits and typical combinations of BOD₅ and ammonia nitrogen listed in the LTP (LDEQ 2000b).

Because the WLAs for minor point sources represented loads that were not simulated in the model, these loads were added to the total load that was simulated in the model. The explicit

MOS for NPS was set to 10% of the NPS load simulated in the model. The explicit MOS for point sources was set to 20% of the total point source loading.

5.2 Nutrient TMDL

As discussed in Section 2.2, Louisiana has no numeric standards for nutrients, but has a narrative standard that states that “the naturally occurring range of nitrogen-phosphorus ratios shall be maintained” (LDEQ 2000a). For this TMDL, nutrients were defined as total inorganic nitrogen (ammonia nitrogen plus nitrate/nitrite nitrogen) and total phosphorus. The value used for the naturally occurring nitrogen to phosphorus ratio was 1.96, which was the median ratio of total inorganic nitrogen to total phosphorus from historical data that was analyzed for a previous nutrient TMDL for the Lake Fausse Pointe/Dauterive Lake system (FTN 2000b).

The first step in calculating the nutrient TMDL was to determine the loads of total inorganic nitrogen that were simulated in the projection model. The loads in the projection model represent the maximum allowable loads that will maintain DO standards. Then the allowable loads of total phosphorus (TP) were calculated by dividing the nitrogen loads by the naturally occurring ratio of total inorganic nitrogen to TP (which was 1.96 as discussed above). The resulting loads of ammonia nitrogen, nitrate-nitrite nitrogen, and TP for Bayou Carron are presented in Table 5.2.

Table 5.2. Nutrient TMDL for Subsegment 060210 (Bayou Carron).

Source of Nutrients	Ammonia-N (kg/day)	Nitrate N (kg/day)	Total P (kg/day)
WLA for Town of Washington STP	1.8	9.0	5.5
WLA for minor point sources	2.2	NA	1.1
MOS for all point sources	1.0	2.2	1.6
LA for other NPS	0.1	0.0	0.1
MOS for all NPS	0.0	0.0	0.0
Total Maximum Daily Load	5.1	11.2	8.3

5.3 Summary of NPS Reductions and Point Source Upgrades

In summary, the projection modeling used to develop the TMDLs above showed that NPS loads need to be reduced an average of approximately 79% along all reaches of Bayou Carron to

maintain the DO standard. No upgrade in treatment was assumed for the Town of Washington; their discharge was modeled with effluent concentrations of 10 mg/L CBOD₅, 2 mg/L ammonia nitrogen, and 5 mg/L DO.

5.4 Seasonal Variation

As discussed in Section 4.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the models account for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

5.5 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 4.1, the highest temperatures occur July through August, the lowest stream flows occur in October through November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS that is not quantified. In addition to the implicit MOS, the TMDLs in this report included explicit MOS of 20% for point source loads and 10% for NPS loads.

6.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. It is therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the LA-QUAL model to vary one input parameter at a time while holding all other parameters to their original value. The projection simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 6.1. Each parameter was varied by $\pm 30\%$, except for temperature, which was varied $\pm 2^\circ\text{C}$.

Values reported in Table 6.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration was the parameter to which DO was most sensitive (13% to 24%). The other parameters causing the greatest variations in the minimum DO values were SOD (11% to 14%), temperature (9% to 11%) and depth (3% to 21%). The model results were slightly sensitive to headwater flow and velocity with variations in predicted DO ranging from 2% to 9%. The model was relatively insensitive to wasteload flow and concentration or decay rates.

Table 6.1. Summary of results of sensitivity analyses.

Input Parameter	Parameter Change	Predicted minimum DO (mg/L)	Percent Change in Predicted DO (%)
Baseline	-	5.01	N/A
BOD decay rate	+30%	4.98	<1
BOD decay rate	-30%	5.00	<1
Headwater flow	+30%	5.04	<1
NH ₃ decay rate	+30%	5.01	<1
NH ₃ decay rate	-30%	5.01	<1
Organic N decay rate	+30%	5.00	<1
Organic N decay rate	-30%	5.01	<1
Wasteload BOD	-30%	5.01	<1
Wasteload DO	+30%	5.01	<1
Wasteload DO	-30%	4.99	<1
Wasteload flow	-30%	5.01	<1
Wasteload NH ₃	+30%	4.99	<1
Wasteload NH ₃	-30%	5.01	<1
Wasteload organic N	+30%	5.01	<1
Wasteload organic N	-30%	5.01	<1
Wasteload flow	+30%	4.95	1
Velocity	+30%	4.92	2
Velocity	-30%	5.10	2
Wasteload BOD	+30%	4.91	2
Depth	+30%	4.87	3
Headwater flow	-30%	4.57	9
Initial temperature	+2oC	4.55	9
Initial temperature	-2oC	4.46	11
SOD	-30%	5.57	11
Reaeration	+30%	5.65	13
SOD	+30%	4.33	14
Depth	-30%	3.95	21
Reaeration	-30%	3.82	24

7.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:IX.1109.A).

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) List of impaired waters. This information is also utilized in establishing priorities for the LDEQ NPS program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) List. The sampling schedule for the first five-year cycle is shown below. The Mermentau and Vermilion-Teche Basins will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins

1999 – Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

8.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, 40 CFR §130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999 Court Order, this TMDL was prepared under contract to EPA. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information, and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. Responses to these comments and additional information are included in Appendix L. EPA has transmitted this revised TMDL to the Court and to LDEQ for incorporation into LDEQ's current water quality management plan.

9.0 REFERENCES

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- LDEQ. 2000d. Bayou Teche Watershed TMDL for Dissolved Oxygen Including WLAs for Twenty-Two Facilities and Addressing Nutrients. Written by J. Carney, Louisiana Department of Environmental Quality, Baton Rouge, LA: November 2000.
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**APPENDICES A THROUGH K ARE
AVAILABLE FROM EPA UPON REQUEST**

APPENDIX L

Responses to Comments

COMMENTS AND RESPONSES
BAYOU CARRON
TMDLs FOR DO AND NUTRIENTS
April 19, 2002

EPA appreciates all comments concerning these TMDLs. Comments that were received are shown below with EPA responses inserted in a different font.

GENERAL COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ) (some of these comments may not apply to this report):

In view of LDEQ's TMDL development schedule and the rapidly approaching deadline, LDEQ has made a limited review of the TMDLs published by EPA on October 15, 2001. LDEQ expects to make a more detailed review on at least some of these TMDLs after the first of the year. In the future, LDEQ requests that EPA provide hard copies of the TMDLs and Appendices for LDEQ review. Several electronic files required software which is not used by LDEQ thus making it impossible to review some portions of several TMDLs. Hard copies will insure that the complete official document is being reviewed and will eliminate the time required for LDEQ to try to put together the document from electronic files. In general, LDEQ found these TMDLs to be unacceptable, based on inadequate data and not implementable.

Federal Register Notice: Volume 66, Number 199, pages 52403 - 52404 (10/15/2001)

- A. Vermilion River Cutoff DO and Nutrients .pdf
- B. Bayou Chene DO .pdf
- C. Bayou du Portage DO .pdf
- D. Bayou Mallet DO, Nutrients and Ammonia .pdf
- E. Bayou Petite Anse DO and Nutrients .pdf
- F. Bayou Tigre DO and Nutrients .pdf
- G. Big Constance Lake and Mermentau Coastal Bays and Gulf Water TMDLs for DO and Nutrients .pdf
- H. Charenton Drainage and Navigation Canal and West Cote Blanche Bay TMDLs for DO and Nutrients.pdf
- I. Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaisses Diversion Channel TMDLs for DO and Nutrients.pdf
- J. Dugas Canal DO and Nutrients .pdf
- K. Franklin Canal DO and Nutrients .pdf
- L. Freshwater Bayou Canal DO and Nutrients .pdf
- M. Irish Ditch/Big Bayou DO .pdf

- N. Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway TMDLs for DO, Nutrients, and Ammonia .pdf
- O. Lake Peigneur DO and Nutrients .pdf
- P. New Iberia Southern Drainage Canal DO and Nutrients .pdf
- Q. Spanish Lake DO .pdf
- R. Tete Bayou DO and Nutrients .pdf
- S. Bayou Carron DO and Nutrients .pdf
- T. West Atchafalaya Basin Protection Levee Borrow Pit Canal DO.pdf

1. Many of these TMDLs are based on models using historical water quality data gathered at a single location rather than survey data gathered at several sites spaced throughout the waterbody. Hydraulic information used was generally not taken at the same time as the water quality data used. The availability of only one water quality data site is not sufficient justification to simulate the subsegment using a one reach, one element model. Additional reaches and elements must be used to represent the subsegment and additional data must be obtained in order for these TMDLs to be valid. The recommended maximum limits cited in the LAQUAL User's Manual for element width and length have been grossly exceeded in many of the models. The spreadsheet calibration and projection graphs that were provided do not match the plots produced by the LA-QUAL model. Please explain why they do not match. The LAQUAL graphics for a few elements produces a graph that does not represent the model output. It's an anomaly of the graphics routine. The calibrations are inadequate due to the lack of a hydrologic calibration and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

Response: The TMDLs were based on existing data plus information that could be obtained with available resources. Each model was developed using the most appropriate hydraulic information and water quality data that were available. The level of detail at which each subsegment was modeled was consistent with the amount of available data. Although having only one element in a model causes inaccuracies in the LAQUAL graphics, having only one element in a model does NOT cause errors in the tabular output (which is what the graphs in the reports are based on). Although LDEQ typically collects more data for model calibration than what was available for calibration of these models, EPA considers these model calibrations and the resulting TMDLs to be valid.

2. LDEQ does not consider any of these waters to be impaired due to nutrients or ammonia. LDEQ does not consider Vermilion River Cutoff (060803), Mermentau Coastal Bays and Gulf Water (050901), Charenton Drainage and Navigation Canal (060601), West Cote Blanche Bay (061001), Bayou Des Glaisses Diversion channel (060207), Grand Lake (070701), Gulf Intracoastal Waterway (050702), Lake Peigneur (060909), New Iberia Southern Drainage Canal (060904) and West Atchafalaya Basin Protection Levee Borrow Pit Canal to be impaired by biochemical oxygen-demanding substances. Many of these waters simply have inappropriate

standards and criteria. The resources spent on developing these TMDLs could have been far more effectively and wisely spent on reviewing, approving, and assisting in the development of appropriate standards and criteria for these waters through the UAA process.

Response: TMDLs were developed for these subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the suspected causes of impairment (organic enrichment/low DO, nutrients, or ammonia) for each subsegment in the EPA Modified Court Ordered 303(d) List.

3. Remove the reference and all references to the unpublished LDEQ document, "Defaults for Uncalibrated Modeling". This is not an acceptable reference and any defaults selected on this basis must be reevaluated and based on acceptable references. Some of the models must be redone because of inappropriately selected defaults. At this time, LDEQ has no plans to revise, complete or publish this document.

Response: The unpublished LDEQ document that is mentioned here was provided to EPA's contractor without any instructions not to use it. The model coefficients listed in that document appear to be reasonable and consistent with values used in other modeling studies in southern Louisiana.

4. The percent reduction of the nonpoint source load must not be reported as an overall average of the individual percent reduction applied to each reach. This approach does not insure that standards will be met in all reaches and will be difficult to implement. In consideration of future implementation plans, LDEQ does not vary the percent reduction required from reach to reach. LDEQ uses a uniform percent reduction within a watershed unless there are unique conditions, such as a general change in landuse, that dictate a further breakdown. These unique conditions must be adequately documented in the report in order to facilitate future implementation plans. Specifying type of land use is helpful in defining nonpoint loading. LDEQ requests a calculation sheet of the NPS reduction percentages and asks that language be added to the report describing the calculation process.

Response: EPA appreciates this comment but believes that an average percent reduction is acceptable. EPA will consider this in future development of TMDLs in Louisiana.

In the lower Mermentau and Vermilion River Basins, much of the nonpoint loading affecting some of these subsegments and adding to their benthic blanket is coming from the tributaries feeding them. Many of the headwater tributaries have recent TMDL's that require dramatic percentage reductions to the nonpoint contributions. By implementing the reductions to nonpoint loads upstream, the current problems in these lower subsegments will be reduced.

Response: EPA recognizes that TMDLs have been developed upstream of several of these subsegments. Implementing upstream reductions in nonpoint loads should require much less reduction of loadings from within these subsegments. The required percent reductions for these subsegments were not intended to be in addition to upstream reductions.

5. The percentage reductions listed were not calculated based on the written procedure described in several TMDLs. These values did not take the MOS into consideration. It is also LDEQ's policy to make a no-man-made load projection run which will estimate the natural background loads. The contractor should include a no-man-made load projection run in each TMDL report.

Response: The percent reductions were calculated by subtracting the projection input value from the calibration input value and then dividing by the calibration input value. This procedure is slightly different than what LDEQ uses but still provides percent reductions that are useful.

6. CBODu and NH3-N were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. Based on the measured data from the last two years of LDEQ water quality surveys, LDEQ objects to the correlation of TOC to CBOD and NH3-N to TKN, unless these correlations are taken from water quality data on the modeled waterbody. Our studies have shown only a moderate correlation between these two parameters within the same waterbody, however when this correlation was attempted across waterbodies extreme variability was seen and the correlation was not judged valid. It is possible that a combination of surrogates will obtain a better correlation, such as TOC along with color, turbidity, pH, etc. LDEQ is currently researching these options.

Response: EPA agrees that it would be ideal to have data collected from the modeled waterbody for relating TOC to CBOD and NH3-N to TKN. However, for these subsegments, there was insufficient data from which these relationships could be developed.

7. LDEQ takes exception to the equating of COD to CBODu in some of the TMDLs. There is no data to support this assumption. No direct correlation has been drawn between these two parameters. The only correlations that have been found are variable and dependant on the type of discharge. LDEQ requests that facilities with only COD limits be removed from the WLA load calculations.

Response: EPA agrees that COD is not an ideal indicator of CBODu. However, EPA believes that most effluents that exert significant COD are likely to exert some oxygen demand in natural waterbodies and therefore the discharges with COD limits should be included in the TMDLs.

8. CBODU and Org-N settling rates were not used. This is not justifiable in areas dominated by agricultural activities and is poor practice for TMDLs on Louisiana waters. The models must be revised to include settling rates.

Response: Without the use of settling rates, all of the pollutant loading remains in the water column where it can consume oxygen. Depending on the model settings for conversion of settled pollutant loading to SOD, the model can be more conservative without settling rates. Other applications of water quality models for TMDLs on southern Louisiana waterbodies have not used settling rates and have been approved by LDEQ.

9. The TMDLs should be for biochemical oxygen-demanding substances instead of DO. DO is an indicator of the impact of biochemical oxygen demanding load, hydrologic modifications, excessive algae blooms, etc.

Response: The TMDLs in Section 5 of each report are already expressed in terms of oxygen demand.

10. Nitrification inhibition option number 2 is valid for Louisiana's waterbodies. Various studies have shown that Louisiana does not have a buildup of NH₃-N in its waterbodies. If option 1 was needed for a proper calibration then that should be stated as such.

Response: The nitrification inhibition option was set based on algorithms in other widely used water quality models. Option 1 has been used in other water quality modeling applications for TMDLs on southern Louisiana waterbodies that have been approved by LDEQ.

11. A winter projection model was not developed for most of the TMDLs. Winter projection models must be developed to address seasonality requirements of the Clean Water Act. Where point sources have seasonally variable effluent limitations or such seasonal variations are proposed, a winter projection model is required to show that standards are met year-round.

Response: As discussed in Section 4.2 of each report, summer is the most critical season for meeting the year round standard for DO for this subsegment. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. Performing additional simulations to evaluate permit limits that are seasonal or hydrograph controlled releases was not required for developing these TMDLs and can be done by LDEQ or by permittees.

12. There was no documentation (LA-QUAL plots) to indicate that the model was calibrated to all hydrologic parameters (i.e. flow, width, depth, time of travel, velocity, chloride balance, etc.). Apparently flow balances were performed, however a flow balance is not a hydrologic calibration. Most of the models must be recalibrated with adequate hydrologic data. Calibration plots for all of the hydrologic parameters must be provided in the appendices.

Response: The values of depth, width, and flow in each model were estimated

based upon the most appropriate available information. Hydraulic calibration of each model was not possible due to a lack of data.

13. The calibration and projection plots for dissolved oxygen must be provided in the body of the reports. Additional projection plots for CBODU, NH3-N, and Org-N must be provided in the appendices.

Response: The placement and number of plots in the draft reports are acceptable.

14. The calibration simulation must be used as the baseline for the sensitivity analysis, not the projection simulation. LDEQ requests that all TMDLs be revised in this regard.

Response: The sensitivity analysis can be developed using either the calibration or the projection as a baseline. EPA will consider this in future development of TMDLs in Louisiana.

15. A list of all point source dischargers must be provided in the body of the reports. Only dischargers with flows that reach the named waterbody should be included in the TMDLs.

In several TMDLs, a default 0.001 MGD flow rate was assigned to dischargers where a flow rate was not available. This practice is unacceptable to LDEQ. This default flow rate is extremely low (LDEQ would typically use 0.005 MGD as a minimum) and could strictly limit these dischargers' allowable permit loads when their permits are renewed. Additional research should be done to determine the facility type and anticipated flow rates of these facilities.

Response: The placement of the list of point source dischargers in the draft reports is acceptable. The dischargers with no flow rate information are believed to have very small flow rates representing a very small portion of the total TMDLs. The actual flow rate for each facility can be determined by LDEQ when the facility's permit is being renewed.

16. LDEQ does not agree with the minor point sources loads being subtracted from the NPS load as was done in several of the TMDLs. The pollutant loads being addressed are non-conservative loads. Many of these dischargers are located on small tributaries to the 303(d) waterbody which have recovered prior to entering into that system. Thus they are not contributing to the pollutant loads in the impaired waterbody. LDEQ's current procedure is to add these loads to the WLA portion of the TMDL.

Response: In the reports for which this comment is applicable, the TMDL calculations have been revised so that these loads are added to the WLA portion of the TMDL (same as LDEQ's procedure). For most of the draft reports, the TMDL calculations already used LDEQ's procedure of adding the minor point sources to the modeled loads.

17. Proper justification must be provided when using a nonpoint source margin of safety value other than the typical LDEQ value of 20%.

Response: The nonpoint margin of safety (MOS) was set to 10% based on other TMDLS on southern Louisiana waterbodies that have either been developed by LDEQ or approved by LDEQ. Eleven TMDL reports from LDEQ's website were reviewed to examine the explicit MOS for nonpoint sources. All 11 of these TMDLS were for oxygen demanding substances in the Mermentau or Vermilion-Teche basins. The explicit MOS for nonpoint sources was set to 20% for 2 reports, 10% for 3 reports, and 0% for 6 reports. Therefore, the value of 10% was considered to be a typical value that did not need special justification.

18. LDEQ has major concerns relating to the use of a one dimensional steady state model in coastal bays, lakes and estuaries. These systems are typically dominated by tides and winds and do not behave like riverine systems. LAQUAL can be used to simulate estuarine systems with riverine characteristics and some tidal influences; however to use it in these applications exceeds the model's recommended input limitations and appears to produce a meaningless output. Also the systems' unique hydrological characteristics do not adapt well to LAQUAL's one-dimensional capabilities. A multi-dimensional model such as WASP should be used for these waters. While a dynamic model would be preferred, a steady-state multi-dimensional model would be acceptable if it adequately addresses tidal influences. LDEQ objects to the use of LAQUAL in determining TMDLS for coastal bays, lakes and estuaries.

Response: A one dimensional steady state model such as LAQUAL was considered to be appropriate for all of these subsegments based on the amount of data that were available. Proper application of a multi-dimensional model or a dynamic model would require much more data and is simply not necessary for these waterbodies. For large, wide waterbodies, WASP will yield the same results as LAQUAL if the configuration of elements and model coefficients are the same between the two models.

19. The report uses the term synoptic survey multiple times. Please describe in detail what area this survey encompassed as well as site locations and what parameters were tested. Also, the raw data from this survey must be included in the appendices as support for the model inputs and calculations.

Response: A description of the synoptic survey and a summary of the data have been added to the appendices for each report in which those data are used.

20. In many of the calibration models the average water quality data from several LDEQ stations were used. It has been LDEQ's experience that a better calibration can be accomplished by using a single day's water quality and flow data. The additional daily values could then be used to perform multiple verifications of the model parameters before proceeding to the projection

stage. The flow data should be collected at the same time as the water quality data in order for the model to be valid.

Response: The models were calibrated to averages over multiple sampling events to minimize the effects of any single field measurement that might be of questionable quality or indicative of conditions that may have lasted only a very short time. For large systems with long residence times, using only a single snapshot of water quality data is often not representative of steady state conditions for that system.

21. Grammatical errors and misspelled words were found in these reports.

Response: The reports have been reviewed for grammar and spelling.

22. There does not appear to be any significant anthropogenic source of nutrients from agriculture, silviculture, aquaculture or urban runoff in many of these subsegments. Therefore, any occurrence of low DO is almost certainly natural. As a result, a UAA for the area is necessary to reset the DO standard. A TMDL is unwarranted for these subsegments, and LDEQ takes exception to EPA generating TMDLs which are impossible to implement.

Response: EPA is required to generate these TMDLs based on the Modified Court Ordered 303(d) List and the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7.

23. LDEQ's nutrient standard is based on total phosphorus (TP) and total nitrogen (TN), not total inorganic nitrogen (TIN). Since phosphorus is not the limiting constituent in Louisiana, the nutrient allocations must be in terms of TN and only TN.

Response: LDEQ's nutrient standard (LAC 33:IX.1113.B.8) does not specify that nitrogen to phosphorus ratios should be based on total nitrogen. However, EPA will consider this in future development of TMDLs in Louisiana.

In the coastal areas, the nitrogen to phosphorus ratio used was based on freshwater streams and is not applicable to brackish Gulf waters. LDEQ takes exception to the calculation of a TMDL based on TN/TP ratios derived from waterbodies other than the modeled waterbody. It is LDEQ's experience that the natural allowable TN/TP ratio is waterbody-specific and can vary dramatically between streams.

Response: EPA agrees that it would be ideal to have a large database of nitrogen to phosphorus ratios for each waterbody. However, because these subsegments have only limited nutrient data, the previously developed nitrogen to phosphorus ratio that was used in the draft reports is considered acceptable.

LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in this TMDL. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site-specific conditions or species and may be inappropriately over protective or under protective. No ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in these TMDLs. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances.

Response: Ammonia TMDLs were developed for two subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the fact that the Modified Court Ordered 303(d) List included ammonia as a suspected cause of impairment for those two subsegments. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia.

24. The implicit margin-of-safety must not be quantified.

Response: The text of the reports has been revised to eliminate any quantification of the implicit margin of safety.

25. EXECUTIVE SUMMARIES: Add summary tables of the WLAs, LAs, and TMDLs showing the allocations and margins of safety.

Response: The summary tables of the WLAs, LAs, and TMDLs can be easily found in Section 5 of each report and do not need to be repeated in the executive summary.

26. Temperature Correction of Kinetics: A temperature correction factor was set for reaeration. It is LDEQ's standard practice to allow LAQUAL to calculate this factor. There is more guidance on this in the LAQUAL User's Manual.

Response: The temperature correction factor for reaeration was set to the value of 1.024 based on guidance in Section 3.3.8 of the LTP.

27. Water Quality Kinetics: The Louisiana reaeration equation was used on reaches that are outside the maximum depth that it was designed for. A more appropriate reaeration equation must be selected.

Response: The Louisiana equation yielded reaeration coefficients that appeared more reasonable than coefficients from other equations.

28. Water Quality standards and designated uses tables did not include the BAC (bacterial criteria) values.

Response: The water quality standards for bacteria are not relevant for these TMDLs.

29. The statement was made in the Initial Conditions paragraphs in several of the reports that temperature was specified because the temperature was not being simulated. The section then states, "For constituents not being simulated, the initial concentrations were set to zero ...". Initial conditions provide a starting point for the iterative solution of modeled constituents. They also provide values for constituents that are needed as input but are not being simulated.

Response: EPA appreciates this comment.

30. Several reports describe the benthic ammonia source rate as a calibration parameter; however a review of the data type 13 calibration input section indicates a value of zero for this parameter, in all reaches.

Response: The benthic ammonia source rate was used as a calibration parameter; the value of that parameter that provided the best fit between predicted and observed values was zero.

31. Calibration, and Projection, Data type 27: A salinity value was set to zero in the boundary conditions for both the calibration and the projection models in several of the TMDLs. With this value set to zero the model will automatically adjust the values of the lowest reach's elements to the value set in the boundary conditions. Since most of the models were one-reach, one-element models, the model automatically set the element salinity to zero, thus calculating an inaccurate value for the DO saturation.

Response: The only models where salinity was set to zero in the downstream boundary conditions were those models where salinity was not considered high enough to have a significant impact on DO saturation.

32. It is not LDEQ's standard procedure to use a zero headwater flow. You may not have input a headwater flow, but the model did. Without a headwater flow the model would have crashed and not run. The model's programming allows for a 0.0000001 cms flow rate when the modeler has not input a headwater flow.

Response: Only two simulations (calibrations for Spanish Lake and Big Constance Lake) used a zero headwater flow. For all practical purposes, 0.0000001 m³/sec is the same as zero flow.

33. Hydraulics and Dispersion: The use of constant widths and depths requires proper justification.

Response: The widths and depths were justified in Section 3 of each report.

34. Several reports state that algae were not simulated because algae did not appear to have

significant impacts. What was the evidence for this statement? Did the contractor have any Chlorophyll a measurements?

Response: This statement was based on general knowledge of the Mermentau and Vermilion-Teche basins as well as a limited amount of diurnal DO data collected in these basins.

SPECIFIC COMMENTS FROM LDEQ FOR BAYOU CARRON:

1. 2.4 Previous Data and Studies, page 2-5: LDEQ agrees with the calibration using the more recent data, however it would be appropriate to include a comparison of the rates and other parameters derived in the original WLA to the ones used in the proposed TMDL.

Response: The original WLA is available for review for making these comparisons.

2. 3.4 Hydraulics and Dispersion , page 3-2, paragraph 1: LDEQ takes exception to the use of the Leopold coefficients and exponents in this situation. The Leopold values are based on waterbodies; which go dry when the flow goes to zero. Based on reconnaissance reports, this waterbody had a measurable width and depth during a zero flow condition. This fact makes the Leopold derived coefficients and exponents a poor choice for determining the stream hydrology in the model.

Response: There were not sufficient data available to develop site-specific hydrologic parameters.

3. 3.8 Headwater and Tributary Flow Rates, page 3-4, paragraph 1:
 - a. Upon a review of a previous TMDL determined by this contractor, it was noted that the drogue velocity multiplied by the estimated stream cross-section was used to determine the estimated flow rate for the stream in question. It is the USGS policy, which LDEQ has supported based on it's own measured data, that the drogue thalweg velocity must be adjusted to obtain an average velocity across the cross-section. The adjustment must take into consideration the depth of the drogue and the drag of the banks to estimate a true average velocity. The measured drogue velocities by the contractor in the previous TMDL were not adjusted, thus over estimating the flow rate measurements by approximately 25-30%. Please review this flow calculation to assure its accuracy.

Response: The flow estimate derived from the drogue velocity and stream cross-section is admittedly an approximation, but was considered accurate enough for these TMDLs.

- b. Why wasn't the flow estimated at the mouth of Bayou Carron using the same method applied to Site 670-2? This estimated flow could have been used to verify the calculated flow rate.

Response: Velocity data were not collected at the mouth of Bayou Carron for the same time period.

4. 3.9 Headwater and Tributary Water Quality, page 3-5, paragraph 2: If the correlation between TOC and the ultimate CBOD is applicable to this waterbody, how does the contractor justify the measured TOC values being close in magnitude while the CBOD₅ values were dramatically different?

Response: EPA assumes this comment refers to FTN synoptic survey data. CBOD₅ values are characteristically highly variable and a data set of two samples is not necessarily representative of actual relationships between variables.

5. Calibration: The NH₃-N and Organic Nitrogen graphs shown in the "cal-results.xls" spreadsheet shows a poor calibration for these two parameters. The calibration must be modified to improve these results.

Response: The calibration for organic nitrogen is very good. The calibration for ammonia was not quite as good, but was the best possible fit between predicted and observed data.

GENERAL COMMENTS FROM LOUISIANA STATE UNIVERSITY AG CENTER (some of these comments may not apply to this report):

Through this letter the Louisiana State University AgCenter would like to submit official comments on TMDLs for dissolved oxygen and nutrients associated allocations for waterbodies in:

- Vermilion River Cutoff
- Bayou Chene
- Bayou Petite Anse
- Bayou Tigre
- Big Constance Lake and Mermentau Coastal Bays and Gulf Water
- Charenton Drainage and Navigation Canal and West Cote Blanche Bay
- Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaisses Diversion Channel
- Dugas Canal
- Franklin Canal

- Freshwater Bayou Canal
- Irish Ditch/Big Bayou
- Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway
- Lake Peigneur
- New Iberia Southern Drainage Canal
- Spanish Lake
- Tete Bayou
- Bayou Carron
- West Atchafalaya Basin Protection Levee Borrow Pit Canal

The number of different TMDLs sent out for comment at the same time may overwhelm the public's ability to comment. With only 30 days to prepare and submit comments it is impossible for a qualified faculty member to review the supporting data in depth and attend to his(her) official responsibilities. I realize that the agency is under time constraints on completing these, but I earnestly request that more time per proposed TMDL be given in the future.

We must make several other general comments and objections that apply to most of the proposed TMDLs. In many cases the data used to calibrate the models for the stream segments was collected in the fall of 2000 near the end of a three year drought. Historic low flows were often commented on in the text of the TMDL. Low flows result in a biased estimate of the natural ability of the stream to reaerate and cleanse itself of pollutants. Low flows also enable the benthic blanket to accumulate and remain in place undisturbed causing overstatement of the benthic oxygen demand and the SOD which were in many cases the primary oxygen demand loads in the stream. While it is true that the high flows that come from storm events carry more organic and sediment loads into the stream, the high flow rates also scour material from the bottoms and move it on to a final deposit at the stream terminus. It was thus that most of Louisiana and all of our coastal areas were built. Prolonged drought conditions do not allow this natural cleansing to occur. Thus it is our belief that the part of the oxygen demand load attributed to benthic and sediments is overstated and that new data must be collected during normal rainfall conditions and the models re-calibrated.

Response: The Louisiana water quality standards are applicable during all flow conditions greater than the 7Q10. Because 7Q10 flow is frequently the most critical condition for maintaining the DO standard, it is desirable to collect field data for model calibration during times when the hydrology is as close as possible to 7Q10 conditions. It is believed that the flow conditions for these waterbodies may have been near 7Q10 conditions, but probably not lower than 7Q10 flows. Therefore, the summer-fall 1998 data is desirable for model calibration.

In far too many of the proposed TMDLs the phrase *"an intensive field survey was not conducted for the study area due to schedule and budget limitations"* was found. If municipalities, agriculture, and business entities are to be asked to make large commitments of funds, time and effort to resolve our water quality problems they deserve to have the benefit of a serious study of the problem. We request that all of the proposed TMDLs that contain this statement have this problem corrected and that TMDLs be prepared based on complete studies.

Response: There is no requirement for collecting a certain amount of data to make a TMDL valid. If additional data are collected in the future by LDEQ, other agencies, or local stakeholders, then those data can be evaluated at the time and the implementation

of the TMDL can be altered as necessary. As outlined in the 1991 EPA document titled "Guidance for Water Quality-Based Decisions: The TMDL Process", developing and implementing TMDLs is a process and not a one-time event.

In several of the proposed TMDLs data was used that is 9 or 10 years old from studies on point source discharges. While the data is probably high quality it assumes that no change in the plant or its load have occurred in the last decade. This assumption may not be defensible. In the TMDLs where a treatment plant was included in the model the margin of error was calculated by using 125% of the design capacity. This assumes a plant will perform at the same level when it is operated in excess of its design load. This assumption is also questionable.

Response: For several subsegments, old data sets were used for calibration because they provided more extensive data than newer data sets. However, all of the projection runs simulated point source discharges based on the most recent information available. Simulating point source discharges at 125% of design flow is simply a way of incorporating an explicit margin of safety and does not assume that the facility can actually treat that much wastewater.

The standard for dissolved oxygen (DO) was held at 5 mg/L in some streams on a year round basis, even if it received or discharged into a stream with 5 mg/L winter and 2 or 3 mg/l summer standards. Other streams had a year DO oxygen standard of 4 mg/L. We strongly suggest that a review be made of the DO standards for all of the streams in south Louisiana that are shallow, sluggish, and subject to tidal influence and that uniform standards be set. In view of the remarks that achieving a DO of 5 mg/L was impossible in some of the streams that had little loading from human activities, we believe that the summer standard of 2 mg/L is much more applicable to these streams.

Response: The TMDLs are required to be developed for the existing DO standard, which is 5 mg/L year round for many of these subsegments. If the DO standard is revised in the future for any of these subsegments, the TMDL and implementation can be altered as necessary as part of the TMDL process.

Many of these TMDLs were drafted by an out of state contractor and do not appear to be as well researched as those drafted by LDEQ. Very little data was included in the contractor drafted TMDLs summaries as compared to the ones prepared by or in conjunction with LDEQ. Additionally, the bulk of the text appeared to be standard wording in all documents with short relevant inserts. We would request that if outside contractors be used in future TMDL assessments that they be held to the same standard of information inclusion that LDEQ provides. Stream diagrams and maps are often needed when reviewing descriptive text on stream location, tributary insert, and exact location.

Response: These TMDLs contain all the required components of a TMDL and the level of detail is considered acceptable. Because these TMDLs could not be funded at the same level as most of LDEQ's DO TMDLs, the analysis and documentation was not as extensive as most of LDEQ's DO TMDLs. However, some of the information that was mentioned in the comment (stream diagrams and maps) was

included in the reports, but they were placed in the appendices (which were available from EPA upon request).

SPECIFIC COMMENTS FROM LSU AG CENTER FOR BAYOU CARRON:

The year round DO standard of 5 mg/L is most probably inappropriate for this stream and should be revised. The proposed NPS reductions of 79% are based on data collected in September, 2000 after a three year drought and do not reflect normal stream conditions. This is evident by the major influence of SOD on the DO content of the stream. A review of the DO standard and re-calibration of the model using data collected after a period of normal rainfall is needed.

Response: As discussed in a response above, using data collected during critical conditions (i.e., flows near 7Q10) is desirable for model calibration.